(12) UK Patent Application (19) GB (11) 2 146 558 A

(43) Application published 24 Apr 1985

(21) Application No 8422898

(22) Date of filing 11 Sep 1984

(30) Priority data

(31) 3333912 (32) 20 Sep 1983 (33) DE

(51) INT CL⁴
B21D 7/16

(52) Domestic classification
B3E 10C3 10H 10L 10M 14K 1E1 1Y J

(56) Documents cited
GB 1387343

(58) Field of search
B3E

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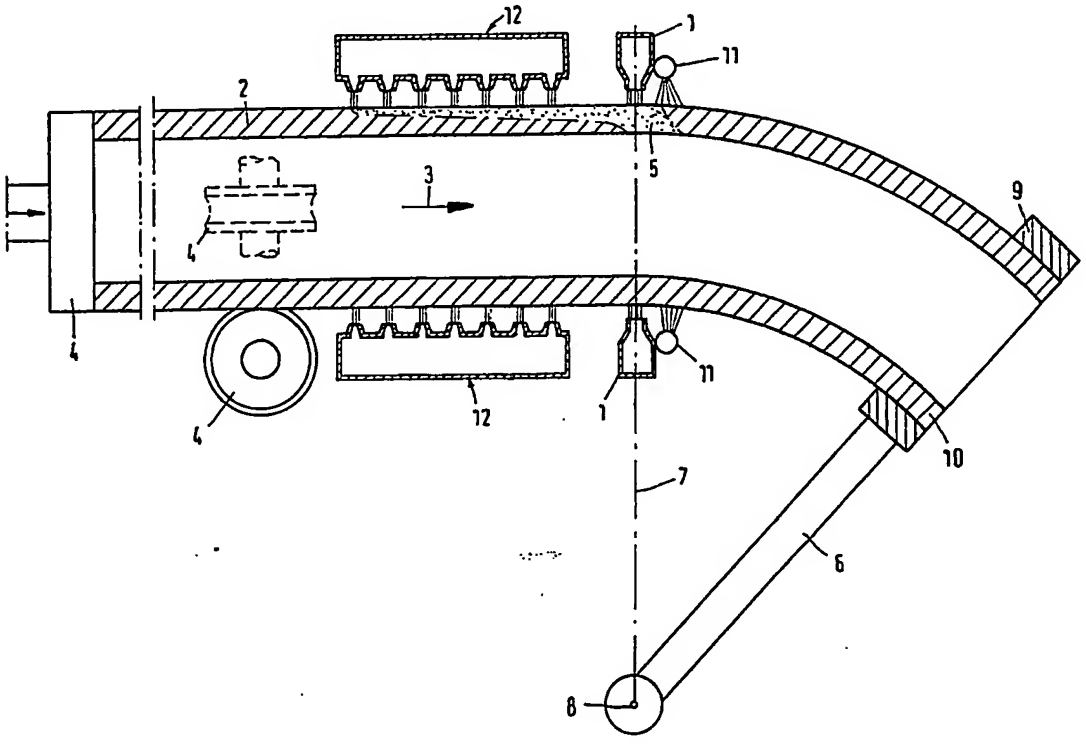
(54) Apparatus for bending tubes

(57) The apparatus comprises a heating ring (1) through which a tube (2) can be axially and continuously urged by means of guiding and driving means (4) disposed ahead of the heating ring (1) and can be heated to the bending temperature in a working zone (5) of limited length. A bending arm (6) is swivellably mounted on an axle (8) disposed remote from the tube (2) in the heating ring plane (7) at right angles to the tube axis, and carries a clamp (9) for the tube front end (10) beyond the ring. A cooling ring (11) directly follows the heating ring (1), surrounding the tube (2) and cooling the tube length just bent inside the working zone (5). To increase the working speed when bending thickwalled tubes (2), the heating ring (1) is preceded by a heating unit (12), which surrounds the tube (2) and with the aid of which the tube (2) can be preheated to a temperature below the bending temperature before entering the heating ring (1) and being worked.



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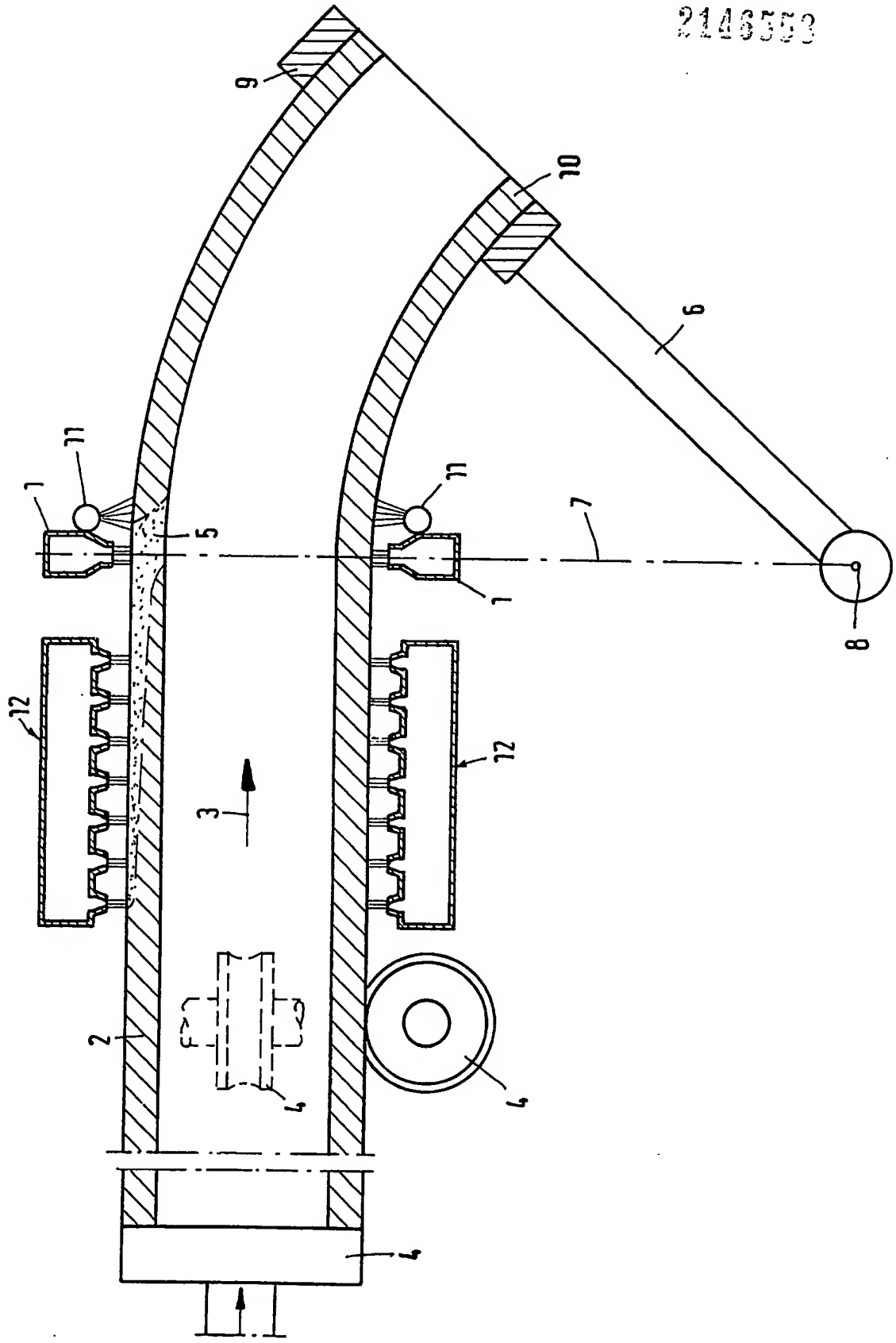

SPECIFICATION

Apparatus for bending tubes

This invention relates to apparatus for bending tubes, having a heating ring through which the tube can be axially and continuously urged by means of guiding and driving means disposed ahead of the heating ring and can be heated to the bending temperature in a working zone of limited length, a bending arm which is swivellably mounted on an axle disposed some distance from the tube in the plane of the heating ring and set at right angles to the axis of the tube, and which arm carries at the other end a clamp for the front end of the tube after it has passed through the heating ring, and a cooling ring directly following the heating ring, surrounding the tube and cooling the tube length just bent inside the working zone.

In known apparatus of this type (U.S. Patent Specification 3 902 344), the heating ring is directly preceded in the direction of advance of the tube by a second cooling ring. In this way the axial length of the working zone, i.e., the zone in which the advancing tube is at the bending temperature and can be plastically worked, is kept particularly short; the shorter the working zone is kept, the smaller are the deviations from the circular arcuate shape in the bent tube. The tube must be heated from roomtemperature or the cooling agent temperature to the bending temperature within the short working zone. The heating ring rating can of course usually be adapted so that the corres ponding temperature rise can still be brought about at a prescribed rate of tube advance. However, difficulties arise with thickwalled tubes, because the tube material only has a finite thermal conductivity, which means that beyond a certain speed of advance the heat supplied by the heating ring can no longer be transferred in full to the tube, so that the latter suffers surface damage. In order to avoid this disadvantage in the bending of thickwalled tubes in the known apparatus, one is obliged to lower the speed of advance of the tube and hence the bending speed, often substantially. If the heating ring consists of an induction heater whose output can only be reduced by suitable cooling, the further disadvantage arises that a substantial proportion of the electrical energy supplied is simply abstracted again by the cooling agent, i.e., dissipated uselessly.

The object of the invention is to provide apparatus of the type initially defined with which satisfactory bends can be produced, even in thickwalled tubes, with no practical limitation of the bending speed.

According to the present invention, theheating ring is preceded in the direction ofadvance of the tube by a heating unit which surrounds the tube and with the aid of which the tube can be preheated to a temperature below the bending temperature before entering the heating ring and being worked.

The invention makes use of the realization that although the restriction of the axial length of the working zone, as practised in the prior art, is of major significance for the production of tube bends with small deviations from the circular arcuate shape, it is not strictly necessary to hold the tube down to room temperature until it enters the heating ring and working zone. On the contrary, the invention teaches that the tube can have a much highter temperature at this stage, the only essential condition being that the corresponding preheating ofthe tube is limited so that no working takes place before entering the heating ring, i.e., that the working zone is not extended in the opposite direction to tube advance. Since the preheating concerned can take place over virtually any convenient axial length of the tube and the heating ring now only has to raise the tube from the preheating to the bending temperature, it becomes possible to bring even thickwalled tubes rapidly up to the bending temperature and to produce satisfactory bends at higher speeds than hitherto. Comparative trials which have taken place have shown that the apparatus of the invention can operate at three times higher bending speeds.

Further and preferred features of the invention will be evident from the following description of an embodiment, by way of example only and with reference to the accompanying drawing, which is a diagrammatic longitudinal section through apparatus for bending tubes.

The apparatus has a heating ring 1, through which the tube 2 can be axially and continuously urged (see the arrow 3), by means of guiding and driving means 4 disposed ahead of the heating ring 1 and which is sufficiently well kmown in the art not to require detailed description here, and the tube can be heated to the bending temperature in a working zone 5 of limited length. The heating ring 1 takes the form of gas burners, but conventional induction heaters could be used on tubes 2 made from electrically conducting material. A bending arm 6 is swivellably mounted on an axle 8 disposed some distance from the tube 2 in the plane 7 of the heating ring 1 and set at right angles to the axis of the tube 2; the other end of the bending arm 6 carries a clamp 9 for the front end 10 of the tube 2 after it has passed through the heating ring 1. The heating ring 1 is directly followed by a cooling ring 11 that surrounds the tube 2 and cools the tube length just bent inside the working zone 5 by spraying it with a cooling agent, for example water.

Looking in the direction of advance 3 of the tube 2, the heating ring 1 is preceded by a heating unit 12, which has an axial length corresponding to a multiple, preferably 4 to 10 times, and as shown about 6 times the axiallength of the heating ring 1 and/or the working zone 5, and also takes the form of gas burners, though for electrically conducting tube material it could take the form of induction heaters. With the aid of the heating unit 12, the tube 2 is preheated to a temperature below the bending temperature, without working, before entering the heating ring 1.

The heat profile is indicated by dots in place of cross-hatching in the upper section of the drawing.

In the heating unit 12, the tube 2 is heated to a limited extent through the hot working limit for the various materials, to a maximum temperature of about 500°C for example, whereas in the heating ring 1 and the working zone 5, the tube 2 attains 850-900°C on the outside and about 850°C on the inside.

CLAIMS

1. Apparatus for bending tubes having a heating ring through which the tube can be axially and continuously urged by means of guiding and driving means disposed ahead of the heating ring and can be heated to the bending temperature in a working zone of limited length, a bending arm which is swivellably mounted on an axle disposed some distance from the tube in the plane of the heating ring and set at right angles to the axis of the tube, and which arm carries at the other end a clamp for the front end of the tube after it has passed through the heating ring, and a cooling ring directly following the heating ring, surrounding the tube and cooling the tube length just bent inside the working zone and the heating ring is preceded in the direction of advance of the tube by a heating unit which surrounds the tube and with the aid of which the tube can be preheated to a temperature below the bending temperature before entering the heating ring and being worked.

2. Apparatus as in Claim 1, wherein the heating unit takes the form of gas burners.

3. Apparatus as in Claim 1, wherein for tubes made from an electrically conducting material, the heating unit takes the form of induction heaters.

4. Apparatus as in any one of Claims 1 to 3, wherein the length of the heating unit corresponds to a multiple of the axial length of the heating ring and/or the working zone.

5. Apparatus as in Claim 4, wherein the heating unit has an axial length corresponding to 5 to 7 times the axial length of the heating ring and/or the working zone.

6. Apparatus for bending tubes substantially as hereinbefore described with reference to the accompanying drawing.

Printed in the UK for HMSO, D8818935, 2/85, 7102.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.